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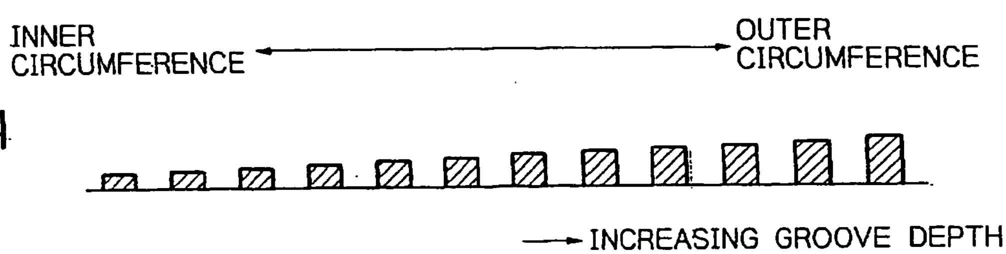
(54) **Optical disk and method of producing the same**

(57) A disk cartridge (1) that holds a disk-shaped recording medium (D) in a cartridge case (2) in such a way that the recording medium (D) can be put into and taken out of the cartridge case (2) comprises a cartridge case body (3) that is composed of top (5) and bottom (6) halves put together with a chamber between them for accommodating the recording medium (D) and having in one side an opening (3a) through which the disk-shaped recording medium (D) is taken out of and put into the cartridge case body (3), a lid (4) that is fitted into the opening (3a) and is slideable in a direction in which the disk-shaped recording medium (D) is taken out of and put into the cartridge case body (3), a stopper removal hole (16) formed in one of the top (5) and bottom (6) halves, a stopper rest (17) formed inside the stopper removal hole (16) and connected to an inner surface thereof, and a stopper (23) whose one end is fixed to the stopper rest (17) and which protrudes into the cartridge case body (3) to stop the lid (4) from sliding.

Fig. 13A



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Description

BACKGROUND OF THE INVENTION

[0001] The present invention relates to an optical disk and a method of producing the same and more particularly to a stamper for molding an optical disk base highly compatible with commercially available CD (Compact Disk) players, a method of producing the stamper, a method of producing an optical disk base, a method of producing an optical disk, and an optical disk base, and an optical disk.

[0002] In parallel with the spread of optical disks, there is an increasing demand for the timely delivery of high quality optical disks to the market. Particularly, to enhance quantity production of optical disks, it is necessary to reduce a disk base molding cycle.

[0003] To produce an optical disk, a stamper formed with a transfer surface is positioned in one of a pair of mold parts forming a cavity therebetween. Molten resin is injected into the cavity and then cooled off. Subsequently, the mold parts are separated in order to remove the cooled resin. As a result, the transfer surface of the stamper is transferred to the resin, forming a recording surface.

[0004] It is a common practice with an optical disk to hold the mold parts at a temperature of about 200°C lower than the temperature of resin to be injected into the cavity. This promotes the cooling and solidification of the resin injected into the cavity. Such a mold temperature is determined by the tradeoff between transferability and an increase in the tact of a disk base molding cycle. Specifically, the mold temperature should be as low as possible for increasing the tact, but would degrade transferability if excessively low. On the other hand, a high mold temperature would enhance transferability, but would increase a period of time necessary for the resin to be cooled to a parting temperature and would thereby lower the yield of optical disks.

[0005] Japanese Patent Laid-Open Publication Nos. 7-178774, 10-149587 and 6-259815 each propose to provide a mold or a stamper with a heat insulating ability so as to enhance both the transferability and the tact of the disk base forming cycle. Specifically, Laid-Open Publication No. 7-178774 teaches a heat insulating body removably positioned in a mold in such a manner as to face the rear of a stamper. Laid-Open Publication No. 10-149587 teaches a heat insulating ceramic layer formed on a mold in such a manner as to face the rear of a stamper. Further, Laid-Open Publication No. 6-259815 teaches a stamper whose front (transfer surface) is plated with Ni (nickel) containing 20 % to 30% of polytetrafluoroethylene by electroless plating. Polytetrafluoroethylene has a grain size of 1.0 μm or less. The resulting Ni film is 50 nm to 70 nm thick.

[0006] However, none of the above conventional technologies can enhance both the transferability and the tact of a disk base molding cycle at a high level. Laid-Open Publication No. 6-259815 has a problem that the Ni film formed on the transfer surface of a stamper obstructs the fine patterning of the transfer surface. Laid-Open Publication No. 10-149587 has a problem that the mold itself must be redesigned or replaced, wasting existing molding equipment.

[0007] Spin coating has customarily been used to coat a molded disk base with an organic pigment which forms a recording layer because spin coating is desirable from the easy process and low cost standpoint. While the thickness distribution of the recording layer can be controlled on the basis of coating conditions, it is difficult to control the distribution of the pigment in guide grooves. Specifically, to form the recording layer, a disk base is caused to spin such that a pigment solution sequentially spreads outward over the entire disk base due to a centrifugal force. However, the centrifugal force differs from one position to another position in the radial direction of the disk base. This, coupled with the fact that the solvent evaporates while spreading outward, causes the pigment to fill outer guide grooves more easily than inner guide grooves.

[0008] It follows that if the guide grooves of the disk base have a uniform configuration from the inner circumference to the outer circumference, the configuration of the guide grooves filled with the pigment differs from one position to another position in the radial direction. This scatters reflectance and tracking error and other signal characteristics and makes it difficult to produce constant quality, reliable optical disks. In addition, the resulting optical disks are not satisfactorily compatible with commercially available CD players.

[0009] Japanese Patent Laid-Open Publication Nos. 5-198011 and 5-198012, for example, disclose implementations for correcting the above difference in configuration between the inner guide grooves and the outer guide grooves filled with the pigment. The implementations are such that the configuration (depth) of the guide grooves to be formed in a disk base or a stamper is intentionally varied beforehand. None of such implementations, however, gives consideration to the decrease in the fluidity of molten resin ascribable to temperature fall. Therefore, the implementations cannot realize desirable transferability alone when a high cycle is desired, aggravating the scattering of optical disks in signal characteristics.

SUMMARY OF THE INVENTION

[0010] It is therefore an object of the present invention to enhance both the transferability and the tact of a disk base molding cycle at the same time.

[0011] It is another object of the present invention to allow a transfer surface to be finely patterned.

[0012] It is yet another object of the present invention to make it needless for existing molding equipment to be redesigned or replaced.

[0013] It is a further object of the present invention to

1st Embodiment

[0022] This embodiment pertains to the production of various kinds of optical disks including a CD, a CD-R, an MD (Mini Disk), an MO (Magnetooptical disk), PD (Phase change optical Disk) and a DVD (Digital Video Disk). In the following description, stampers are classified into a heat-insulated master stamper and a heat-insulated son stamper produced from a master by transfer via a mother. Both of these stampers are used to produce optical disk bases.

[0023] First, a heat-insulated master stamper and a method of producing it will be described with reference to FIGS. 2A-2F and FIG. 3. As shown in FIG. 2A, a photoresist layer 3 is formed on a glass master 2 and then exposed by a laser beam and developed to form a pattern of fine projections and recesses 4 constituting a disk surface pattern. The glass master 2 with the pattern 4 serves as a master. An electroconductive film layer 5 is formed on the pattern 4. Subsequently, as shown in FIG. 2B, Ni electroforming is effected by using the electroconductive film layer 5 as a cathode, thereby forming an about 25 μm thick Ni layer 6. The Ni layer 6 serves as an Ni electroformed layer and a metal layer for master transfer.

[0024] As shown in FIG. 2C, a heat insulating layer 7 is formed on the Ni layer 6 and implemented by a heat resistant polymer. Specifically, the Ni deposited surface of the electroconductive film 4 is coated with a partially-imidized straight chain type polyamide acid solution by spin coating or spraycoating. The coated polyamide acid solution is then subjected to cyclodehydration with the application of heat thereto to imidize the coated polyamide acid solution. As a result, a polyimide heat insulation layer 7 is formed. The heat insulating layer 7 has a thermal conductivity preferably lower than 94 W/m.k and lower than the thermal conductivity of Ni customarily used for a mold not shown. The heat insulating layer 7 should preferably be 150 μm thick or less, more preferably between 5 μm and 150 μm. The heat insulating layer 7 may be implemented by a polyamideimide heat insulating layer, if desired. The polyamideimide heat insulating layer may be formed by the same technology as used for the polyimide insulating layer 7. The heat insulating layer 7, whether it be polyimide or polyamideimide, can be easily provided with any desired thickness.

[0025] As shown in FIG. 2D, a second electroconductive film 8 is formed on the polyimide heat insulating layer 7. Then, as shown in FIG. 2E, Ni electroforming is effected by using the second electroconductive film 8 as a cathode, thereby forming a second Ni layer 9. The resulting laminate formed on the glass master 2 and made up of the first Ni layer 6, heat insulating layer 7 and second Ni layer 9 is about 300 m thick and has increased mechanical strength.

[0026] Subsequently, as shown in FIG. 2, the laminate is separated from the glass master 2 to constitute a heat-insulated master stamper blank 10. After the photoresist 3 remaining on the blank 10 has been removed, there are sequentially executed the formation of a protection film, grinding of the rear surface, inside and outside diameter pressing, and signal and defect tests. As a result, a heat-insulated master stamper 1 is completed and includes a transfer surface 11 to which the pattern 4 of the glass master 2 is transferred. FIG. 3 shows part of the above master stamper 1. As shown, the master stamper 1 is made up of the Ni layer 6, heat insulating layer 7 and Ni layer 9 and has the transfer surface 11 on its front.

[0027] Next, a heat-insulated son stamper and a method of producing it will be described with reference to FIGS. 4, 5A through 5N and 6. FIG. 4 demonstrates a sequence of steps for producing a heat-insulated son stamper 21. First, a photoresist layer 23 is formed on a glass master 22 (step S1; FIG. 5A) and then exposed by a laser beam and developed to form a pattern of fine projections and recesses 24 constituting a surface transfer surface pattern (step S2; FIG. 5B). An electroconductive film 25 is formed on the pattern 24 (step S3; FIG. 5B). Subsequently, Ni electroforming is effected by using the electroconductive film 25 as a cathode, thereby forming an about 300 μm thick Ni layer 26 (step S4; FIG. 5D). The Ni layer 26 serves as an Ni electroformed layer and a mater transfer metal layer. The Ni layer 26 is separated from the glass master 22, and then the photoresist 23 remaining on the Ni layer 26 is removed. As a result, a master 27 with the pattern 24 is produced (step S5; FIG. 5E).

[0028] After the separation of the above master 27 (step S6; FIG. 5F), an Ni oxide film 28 and an about 300 μm thick second Ni layer 29 are sequentially formed (step S7; FIG. 5G). The second Ni layer 29 plays the role of a mother transfer metallic layer. Subsequently, the Ni layer 29 is separated from the master 27. As a result, a mother 31 is obtained and has an inverted transfer surface pattern 30 to which pattern 24 is transferred (step S8; FIG. 5H).

[0029] After preprocessing (step S9), the mother 31 is peeled off and then formed with an Ni oxide film 32 like the master 27 (step S10; FIG. 51). Then, an about 25 μm thick Ni layer 33 is formed by electroforming (step S11; FIG. 5J). This Ni layer 33 serves as an Ni electroformed layer and a son transfer metallic layer. Subsequently, after rinsing and drying (step S12) and the following preprocessing for forming an insulating layer (step S13), an insulating layer 34 playing the role of a son heat insulating layer is formed on the Ni layer 33 and implemented by a heat resistant polymer (step S14; FIG. 5K). As for the method of forming the heat insulating layer 34 on the Ni layer 33 and the kind of the layer 34, the above procedure is identical with the previous procedure described in relation to the master stamper 1.

[0030] After the formation of the heat insulating layer 34, an electroconductive film 35 is formed on the layer 34 (step S15; FIG. 5L). Then, Ni electroforming is effected by using the electroconductive film 35 as a cathode,

formed on the pregroove pattern 52, Ni electroforming is effected by using the electroconductive film 5 as a cathode, thereby forming the about 25 μm thick Ni layer 6 (see FIG. 2B). The Ni layer 6 has on its entire surface the transfer surface 11 to which the pregroove pattern 52 is transferred. After the heat insulating layer 7 and second Ni layer 9 have been laminated on the Ni layer 6, the Ni layer 6, insulating layer 7 and Ni layer 9 are separated from the glass master 2. As a result, the heat-insulated master stamper 1 is formed (see FIG. 3).

[0040] Subsequently, the optical disk base 41 is formed by injection molding, as follows. After the stamper 1 has been fixed in place in a cavity 56 formed between a stationary mold part 54 and a movable mold. part 55, molten resin, not shown, is injected into the cavity 56 via a nozzle 57 formed in the movable mo.ld part 55. Then, the molten resin is compressed between the two mold parts 54 and 55. Subsequently, the mold parts 54 and 55 are separated from each other in order to remove the cooled and solidified resin, i.e., optical disk base 41. For the optical disk base 41, use may be made of any one of various stampers including the heat-insulated master stamper 1 and son stamper 21 stated earlier.

[0041] The above optical disk base 41 is coated with a pigment or recording material in order to form a light absorption layer 58 (see FIG. 9). Specifically, after the optical disk base 58 has been positioned on a turntable 59, it is coated with a 3.5 wt% dimethylcyclohexane solution of Pd phthalocyanine having a single 1-isopropylisoamyloxy radical at the α position of each of four benzene rings constituting phthalocyanine. Subsequently, the turntable 59 is turned to effect spin coating at a speed of 2,000 rpm (revolutions per minute). Then, the base 41 is dried at 70°C for 2 hours (curing in an oven) so as to form the light absorption layer 58 which is 100 nm thick.

[0042] Subsequently, a reflection layer 60 and a protection layer 61 are sequentially formed, as follows (see FIG. 6). While the base 41 with the light absorption layer 58 is held on the turntable 59, a sputtering device 58 with a silver target mounted thereon forms a silver reflection layer 60 on the light absorption layer 58 to a thickness of 100 nm. As a result, the base 41 is provided with a light reflection surface 63. Further, after ultraviolet-setting resin has been deposited on the reflection layer 60 by spin coating, ultraviolet rays are radiated toward the reflection layer 60 in order to form a 6 μm thick protection layer 61.

[0043] Thereafter, the signal characteristic and mechanical characteristic of the media are tested, and labels are printed only on the acceptable media by screen printing. The media with the labels each are subjected to hard coating to complete the CD-R or optical disk 51. FIG. 9 is a section showing the completed CD-R 51. Such CD-Rs 51 will be packaged and shipped later.

[0044] The above illustrative embodiment has various unprecedented advantages, as enumerated below.

(1) A stamper includes a heat insulating layer extending in parallel to, but not contacting, a transfer surface used to form a disk base. Therefore, at the time of injection molding using the stamper, even when a mold having mold temperature lower than conventional is used, resin contacting the stamper remains at high temperature and insures sufficient transferability. It follows that desirable transferability is achievable at high transfer temperature, and in addition the tact of a disk base molding cycle is improved at low mold temperature.

(2) The heat insulating layer has thermal conductivity lower than 94 W/m. k, i.e., lower than the thermal conductivity of Ni customarily used for a mold. The heat insulating layer can therefore exhibit a heat insulating effect.

(3) The heat insulating layer is formed of a heat resistant organic polymer. This, coupled with the low thermal conductivity of the heat insulating layer, prevents a surface portion (stamper transfer portion) from being sharply cooled off. Molten resin is therefore free from noticeable skin layer and insures desirable transferability.

(4) For the heat resistant organic polymer, use is made of polyimide. It is therefore possible to provide the heat insulating layer with any desired thickness by using a polyimide acid that is a precursor of polyimide.

(5) The above polyimide has a thickness ranging from 5 μm to 150 μm and therefore an adequate degree of insulating ability. This allows both the sufficient transferability and improvement in the tact of the optical disk base molding cycle to be achieved at the same time.

(6) For the heat resistant organic polymer, use is made of polyimideamide. It is therefore possible to provide the heat insulating layer with any desired thickness by using a polyamide acid that is a precursor of polyamideimide.

(7) The above polyamideimide has a thickness ranging from 5 μm to 150 μm and therefore an adequate degree of insulating ability. This allows both the sufficient transferability and improvement in the tact of the optical disk base molding cycle to be achieved at the same time.

(8) The heat insulating layer is formed of a heat resistant inorganic polymer. This, coupled with the low thermal conductivity of the heat insulating layer, prevents a surface portion (stamper transfer portion) from being sharply cooled. Molten resin is therefore free from a noticeable skin layer and insures desirable transferability.

(9) When the heat resistant inorganic polymer is implemented by a ceramic, the heat insulating layer can be easily formed by flame spraying, plasma jet, ion plating or similar technology.

(10) The above ceramic has a thickness ranging from 50 μm to 300 μm and therefore an adequate

time of injection molding using the stamper, even when a mold having mold temperature lower than conventional is used, resin contacting the stamper remains at high temperature and insures sufficient transferability. It follows that desirable transferability is achievable at high transfer temperature, and in addition the tact of a disk base forming cycle is improved at low mold temperature.

(24) In the above procedure, the master transfer metal layer, mother transfer metal layer, son transfer metal layer, master metal layer and son metal layer are formed of Ni. Therefore, the master transfer metal layer and master metal layer can be easily laminated by Ni electroforming. In addition, the thickness of each layer can be readily controlled.

(25) With the above procedure, it is also possible to achieve the previously stated advantages (21) and (22).

(26) The illustrative embodiment produces an optical disk base by injecting molten resin into a cavity formed between a pair of mold parts and accommodating any one of the above stampers, and separating the mold parts in order to remove the cooled resin. Therefore, at the time of injection molding using the stamper, even when a mold having mold temperature lower than conventional is used, resin contacting the stamper remains at high temperature and insures sufficient transferability. It follows that desirable transferability is achievable at high transfer temperature, and in addition the tact of a disk base forming cycle is improved at low mold temperature.

(27) The illustrative embodiment produces an optical disk by injecting molten resin into a cavity formed between a pair of mold parts and accommodating any one of the above stampers, separating the mold parts in order to remove the cooled resin, coating the transfer surface of the resin with a recording material to thereby form a light absorption layer, and forming a reflection film on the light absorption layer. Therefore, at the time of production of an optical disk base, even when a mold having mold temperature lower than conventional is used, resin contacting the stamper remains at high temperature and insures sufficient transferability. It follows that desirable transferability is achievable at high transfer temperature, and in addition the tact of a disk base forming cycle is improved at low mold temperature.

(28) The optical disk base of the illustrative embodiment is produced by the above method. Therefore, at the time of production of an opticaldisk base, even when a mold having mold temperature lower than conventional is used, resin contacting the stamper remains at high temperature and insures sufficient transferability. It follows that desirable transferability is achievable at high transfer temperature, and therefore a high quality optical disk is achievable because of the desirable signal characteristic of the optical disk base.

(29) The optical disk of the illustrative embodiment is produced by the above method. Therefore, at the time of production of an optical disk base, even when a mold having mold temperature lower than conventional is used, resin contacting the stamper remains at high temperature and insures sufficient transferability. It follows that desirable transferability is achievable at high transfer temperature, and therefore a high quality optical disk is achievable because of the desirable signal characteristic of the optical disk base.

2nd Embodiment

[0045] Referring to FIGS. 10A through 10D, an alternative embodiment of the present invention that pertains to the production of a stamper will be described. First, how a mother 1 shown in FIG. 10A is formed before the sequence of steps shown in FIGS. 10A through 10D will be described. After an electroconductive film has been formed on a pattern of fine projections and recesses formed on a glass master, an Ni layer is formed by electroforming by using the electroconductive film as a cathode. Then, the glass master is separated to produce a master. After the master has been peeled off, an Ni layer is formed by electroforming and then separated from the master in order to produce the mother 1 having an inverted projection and recess pattern 1a.

[0046] After the mother 1 has been subjected to peeling and film forming like the master (not shown specifically), an about 25 μm thick Ni layer 2a is formed on the mother 1 by electroforming, as shown in FIG. 10A. In FIG. 10A, the reference numeral 10 designates a master obtained at the end of the procedure to be described; a general positional relation between masks formed on the Ni layer 2a and the recording area of the stamper 10 is shown.

[0047] As shown in FIG. 10A, masks 3a and 3b implemented by Teflon (polytetrafluoroethylene or PTFE) are respectively formed in the regions of the Ni layer 2a corresponding to the region 10a of the stamper 10 5 mm inward of the innermost circumference of the recording area and the region 10b of the stamper 10 between a position 5 mm outward of the outermost circumference of the recording area and the edge. The Ni layer 2a is coated with a partially-imidized straight chain type polyamide acid solution (e.g. Torenese #3000 available from Toray Industries Inc. by spin coating or spray coating. The coated polyamide acid solution is then subjected to cyclodehydration with the application of heat thereto to imidize the coated polyamide acid solution. As a result, a polyimide heat insulation layer 4 is formed, as shown in FIG. 10B.

[0048] After the masks 3a and 3b have been removed from the above laminate, an electroconductive film, not shown, is formed. Subsequently, as shown in FIG. 10C,

2. At this instant, as shown in FIG. 12, the relative intensity of the laser beam is sequentially increased from the inner circumference toward the outer circumference of the glass master 2. After the exposure, the pattern was developed to form guide grooves shown in FIG. 13A in the glass master 2. As shown, the guide grooves have depths sequentially increasing from the inner circumference toward the outer circumference. The illustrative embodiment was extremely effective when the outermost guide groove had a depth greater than the depth of the innermost groove by 50 Å to 500 Å, particularly by 100 Å to 300 Å. Of course, curves shown in FIGS. 11 and 12 are only illustrative and may be modified in various ways.

[0056] Alternatively, as shown in FIG. 13B, the guide grooves may have their width sequentially increased form the inner circumference toward the outer circumference. The illustrative embodiment achieved a desirable effect when the outermost guide groove had a width greater than the width of the innermost guide groove by 0.02 μm to 0.1 μm. If desired, both the depths and widths of the guide grooves may be sequentially varied. For example, a desirable effect was achieved when the outermost guide groove was deeper than the innermost guide groove by 100 Å or less and broader than the innermost guide groove by 0.05 μm or less.

[0057] The glass master 2 with the fine projection and recess pattern 4 sequentially varying in configuration, as stated above, serves as a master.

[0058] In the illustrative embodiment, at the time of formation of the heat insulating layer 34 shown in the step S14 of FIG. 4 and in FIG. 5K, masks implemented by Teflon are respectively formed in the regions of the Ni layer 33 corresponding to the region of the recording area 5 mm inward of the innermost circumference and the region of the same between a position 5 mm outward of the outermost circumference and the edge. Subsequently, a heat insulating layer or son heat insulating layer 34 is formed on the Ni layer 33 by use of a heat resistant polymer.

[0059] Further, in the illustrative embodiment, the signal characteristic and mechanical characteristic of the resulting optical disks were measured. Specifically, information was written in the recording area between a diameter of 44.7 mm and a diameter of 118 mm and then read out by a semiconductor laser beam having a wavelength of 782 nm, NA of 0. 47 and power of 0.5 mW at a liner velocity of 1.3 m/s. During reproduction, a reflectance, a radial contract signal and a push-pull signal were measured. The measurement showed that all of the above three factors were evenly distributed over the entire disk surface. Moreover, the optical disks were satisfactorily compatible with various CD players available on the market.

[0060] For comparison, when a stamper for an optical disk base was entirely implemented by Ni and used to produce a disk base, the guide groove pattern of the stamper was not sufficient transferred to the disk base, degrading the signal characteristic of the resulting optical disk.

[0061] Further, when a disk base was formed in the same manner as in the first embodiment except that the photoresist had a uniform thickness and that the laser beam had constant intensity. Although this comparative example implemented sufficient transferability of the guide groove pattern, it was apt to cause the recording layer to fill up the guide grooves in the outer peripheral portion, also degrading the signal characteristic of the resulting optical disk.

4th Embodiment

[0062] In this embodiment, an optical disk base is formed in the same manner as in the third embodiment except that the heat insulating layer is implemented by zirconia or similar ceramic. Ceramics can be easily deposited by effecting, e.g., the flame spraying, plasma jet or ion plating. The thickness of the heat insulating layer was varied to 20 μm, 50 m, 100 μm, 150 μm and 250 μm. The heat insulating layer 4 implemented by a ceramic insures sufficient transferability and improves tact of the disk molding cycle if it is 50 μm thick or above. Experiments were conducted by forming the same layers as in the third embodiment, including the recording layer, on disk bases produced with 100 m, 150 m and 250 m thick stampers. Measurement showed that the reflectance, radial contrast signal and push-pull signal of each disk base was evenly distributed over the entire surface. Moreover, the above disk bases were sufficiently compatible with various CD players available on the market. Presumably, such desirable results are achievable even when the ceramic heat insulating layer is 300 μm thick or less.

[0063] The third to fifth embodiments shown and described achieve the following various advantages.

(1) Not only transferability is enhanced at the time of molding, but also the tact of the base molding cycle is improved. When guide grooves have an identical configuration, optical disks sufficiently compatible with commercially available CD players can be produced.

(2) A heat insulating layer extends in parallel to, but not contacting, a transfer surface used to mold a disk base. The configuration of the guide grooves is sequentially varied from the inner circumference toward the outer circumference. Therefore, at the time of injection molding using the stamper, even when a mold having mold temperature lower than conventional is used, resin contacting the stamper remains at high temperature and insures sufficient transferability. It follows that desirable transferability is achievable at high transfer temperature, and in addition the tact of a disk base molding cycle is improved at low mold temperature.

(3) The guide grooves have depths and/or widths

heat resistant organic polymer comprises polyimide.

20. A method as claimed in claim 19, wherein the polyimide has a thickness between 5 μm and 150 μm.

21. A method as claimed in claim 15, wherein the heat resistant organic polymer comprises polyimideamide.

22. A method as claimed in claim 21, wherein the polyamideimide has a thickness between 5 μm and 150 μm.

23. A method as claimed in claim 15, wherein said heat insulating material comprises a heat resistant inorganic polymer.

24. A method as claimed in claim 23, wherein the heat resistant inorganic polymer comprises a ceramic.

25. A method as claimed in claim 24, wherein the ceramic has a thickness between 50 μm and 300 μm.

26. A method as claimed in claim 15, wherein said heat insulating material comprises a metal.

27. A method as claimed in claim 26, wherein the metal is close in a coefficient of linear expansion to Ni used as a stamper material.

28. A method as claimed in claim 26, wherein the metal comprises Bi.

29. A method as claimed in claim 28, wherein the Bi has a thickness between 150 μm and 300 μm.

30. A method of producing a stamper for molding an optical disk base, comprising the steps of:

electroforming on a mother stamper having an inverted transfer surface pattern an Ni layer having a transfer surface to which said inverted transfer surface pattern is transferred;
forming a heat insulating layer on said Ni layer; and
separating said mother stamper from said Ni layer.

31. A method as claimed in claim 30, further comprising the step of forming a second Ni layer on said heat insulating layer.

32. A method as claimed in claim 30, wherein said heat insulating material has a thermal conductivity lower than 94 W/m. k.

33. A method as claimed in claim 30, wherein said heat insulating material comprises a heat resistant organic polymer.

34. A method as claimed in claim 33, wherein the heat resistant organic polymer comprises polyimide.

35. A method as claimed in claim 34, wherein the polyimide has a thickness between 5 μm and 150 μm.

36. A method as claimed in claim 30, wherein the heat resistant organic polymer comprises polyimideamide.

37. A method as claimed in claim 36, wherein the polyamideimide has a thickness between 5 μm and 150 μm.

38. A method as claimed in claim 30, wherein said heat insulating material comprises a heat resistant inorganic polymer.

39. A method as claimed in claim 38, wherein the heat resistant inorganic polymer comprises a ceramic.

40. A method as claimed in claim 39, wherein the ceramic has a thickness between 50 μm and 300 μm.

41. A method as claimed in claim 30, wherein said heat insulating material comprises a metal.

42. A method as claimed in claim 41, wherein the metal is close in a coefficient of linear expansion to Ni used as a stamper material.

43. A method as claimed in claim 41, wherein the metal comprises Bi.

44. A method as claimed in claim 43, wherein the Bi has a thickness between 150 μm and 300 μm.

45. A method of producing a stamper for molding an optical disk base, comprising the steps of:

forming photoresist on a glass master;
exposing said photoresist with a laser and then developing said photoresist to thereby form a transfer surface pattern of fine projections and recesses;
metallizing a surface of said photoresist formed with said transfer surface pattern and then electroforming a master transfer metal layer;
forming a master heat insulating layer on said master transfer metal layer;
forming a master metal layer on said master heat insulating layer; and
separating said glass master and then removing said photoresist.

46. A method as claimed in claim 45, wherein said master transfer metal layer and said master metal layer are formed of Ni.

47. A method as claimed in claim 46, wherein said master transfer metal layer is 100 μm to 25 μm thick.

48. A method as claimed in claim 46, wherein said master transfer metal layer is 25 μm to 5 μm thick.

49. A method as claimed in claim 45, wherein said master transfer metal layer is 100 μm to 25 μm thick.

50. A method as claimed in claim 45, wherein said master transfer metal layer is 25 μm to 5 μm thick.

51. A method of producing a stamper for molding an optical disk base, comprising the steps of:

producing a master by forming photoresist on a glass master, exposing said photoresist with a laser and then developing said photoresist to thereby form a transfer surface pattern of fine

67. A stamper as claimed in claim 61, wherein said heat insulating material comprises a heat resistant inorganic polymer.
68. A stamper as claimed in claim 67, wherein the heat resistant inorganic polymer comprises a ceramic.
69. A stamper as claimed in claim 68, wherein the ceramic has a thickness of 300 μm or below.
70. A stamper as claimed in claim 61, wherein said heat insulating material comprises a metal.
71. A stamper as claimed in claim 70, wherein the metal is close in a coefficient of linear expansion to Ni used as a stamper material.
72. A stamper as claimed in claim 70, wherein the metal comprises Bi.
73. A stamper as claimed in claim 72, wherein the Bi has a thickness of 300 μm or below.
74. A stamper for molding an optical disk base produced by a method comprising the step of positioning a heat insulating material beneath a recording area formed on a surface of a stamper for molding an optical disk.
75. In an apparatus for molding an optical disk base including means for producing an optical disk base in accordance with a method of producing a stamper for molding said optical disk base, a heat insulating material is positioned beneath a recording area formed on a surface of a stamper for molding an optical disk.
76. In a method of producing an optical disk base by using a stamper for molding an optical disk in accordance with a method of producing said stamper, a heat insulating material is positioned beneath a recording area formed on a surface of a stamper for molding an optical disk.

Claims

1. A stamper for molding an optical disk base, comprising:

   a transfer surface (6, 11; 33, 38) for molding the optical disk base;
   a heat insulating material (7; 34) extending in parallel to, but not contacting, said transfer surface; and
   guide grooves sequentially varied in configuration from an inner circumference toward an outer circumference.

2. A stamper as claimed in claim 1, wherein said guide grooves have depths sequentially increasing from the inner circumference toward the outer circumference.

3. A stamper as claimed in claim 1 or 2, wherein an outermost guide groove has a depth greater than a depth of an innermost guide groove by 50 Å to 500 Å.

4. A stamper as claimed in claims 1 or 2, wherein an outermost guide groove has a depth greater than a depth of an innermost guide groove by 100 Å to 300 Å.

5. A stamper as claimed in any of claims 1 to 4, wherein said guide grooves have widths sequentially increasing from an inner circumference toward an outer circumference.

6. A stamper as claimed in claim 5, wherein an outermost guide groove has a width greater than a width of an innermost guide groove by 0.02 μm to 0.1 μm.

7. A stamper as claimed in any of claims 1 to 6, wherein said heat insulating material has a thermal conductivity lower than 94 W/m.k.

8. A stamper as claimed in any of claims 1 to 7, wherein said heat insulating material (7; 34) comprises a heat resistant organic polymer.

9. A stamper as claimed in claim 8, wherein the heat resistant organic polymer comprises polyimide or polyamideimide.

10. A stamper as claimed in claim 9, wherein the polyimide or the polyamideimide is 5 μm to 150 μm thick.

11. A stamper as claimed in any of claims 1 to 7, wherein said heat insulating material comprises a heat resistant inorganic polymer.

12. A stamper as claimed in claim 11, wherein the heat resistant inorganic polymer comprises a ceramic.

13. A stamper as claimed in claim 12, wherein the ceramic is 50 μm to 300 μm thick.

14. A stamper as claimed in any of claims 1 to 7, wherein said heat insulating material comprises a metal.

15. A stamper as claimed in claim 14, wherein the metal is close in a coefficient of linear expansion to Ni used as a stamper material.

16. A stamper as claimed in claim 14 or 15, wherein the metal comprises Bi.

17. A stamper as claimed in claim 16, wherein the Bi is 150 μm to 300 μm thick.

18. A base for molding an optical disk, wherein guide grooves have a configuration sequentially varied from an inner circumference toward an outer cir-

Fig. 1

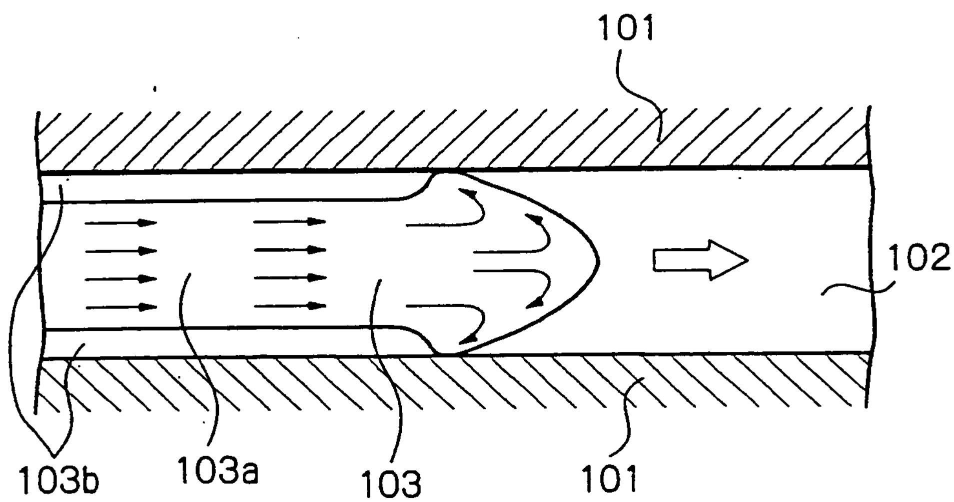


Fig. 4

S1 APPLICATION OF PHOTORESIST

S2 LASER EXPOSURE & DEVELOPMENT

S3 METALLIZATION : 500Å Ni SPUTTERING

S4 300μm MASTER Ni ELECTROFORMING

S5 SEPARATION OF GLASS & REMOVAL OF PHOTORESIST

S6 PEELING & FILM FORMING

S7 300μm MOTHER Ni ELECTROFORMING

S8 SEPARATION OF MASTER

S9 PREPROCESSING

S10 PEELING & FILM FORMING

S11 25μm FIRST Ni ELECTROFORMING

S12 RINSING & DRYING

S13 PREPROCESSING OF HEATING LAYER FORMING SURFACE

S14 FORMATION OF 30μm HEAT INSULATING LAYER

S15 METALLIZATION : 500Å Ni SPUTTERING

S16 250μm SECOND Ni ELECTROFORMING

S17 RINSING & DRYING

S18 SEPARATION

S19 FORMATION OF PROTECTION FILM

S20 REAR GRINDING

S21 INSIDE & OUTSIDE DIAMETER PRESSING

S22 TESTS : DEFECTS, SIGNALS, APPEARANCE & DIMENSIONS

Fig. 5H

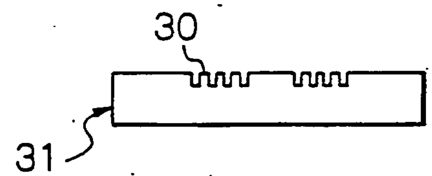


Fig. 5I

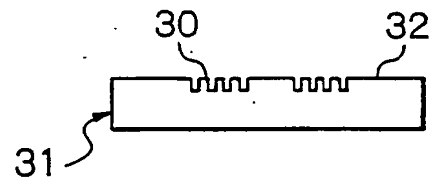


Fig. 5J

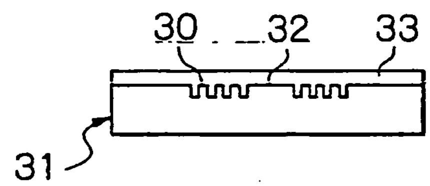


Fig. 5K

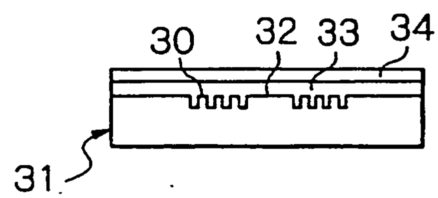


Fig. 5L

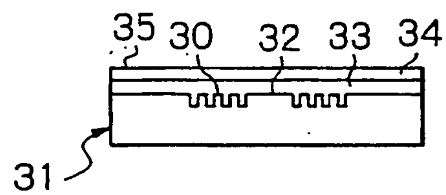


Fig. 5M

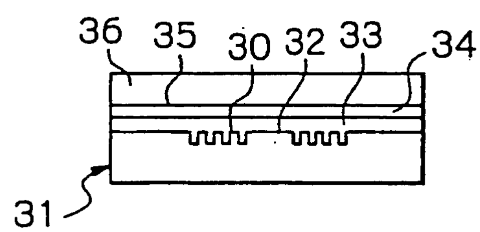


Fig. 5N

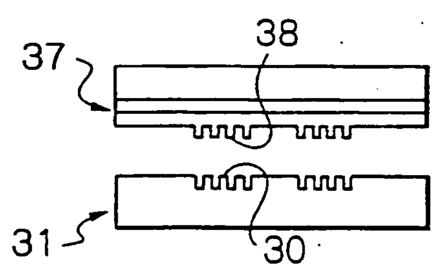


Fig. 8

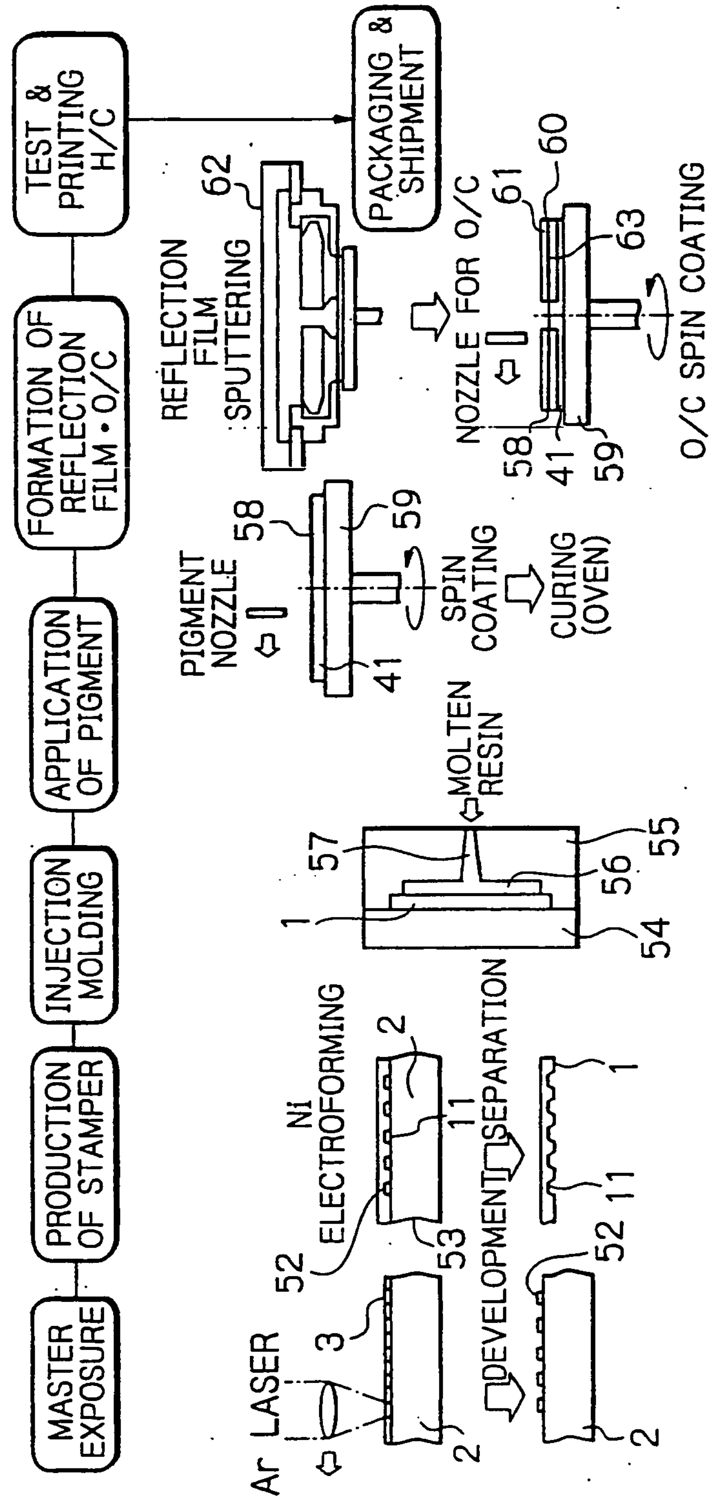

MASTER EXPOSURE
PRODUCTION OF STAMPER
INJECTION MOLDING
APPLICATION OF PIGMENT
FORMATION OF REFLECTION FILM • O/C
TEST & PRINTING H/C
PACKAGING & SHIPMENT
Ar LASER
DEVELOPMENT
Ni ELECTROFORMING
SEPARATION
MOLTEN RESIN
PIGMENT NOZZLE
SPIN COATING
CURING (OVEN)
REFLECTION FILM SPUTTERING
NOZZLE FOR O/C
O/C SPIN COATING
1
2
3
11
41
52
53
54
55
56
57
58
59
60
61
62
63

Fig. 10A

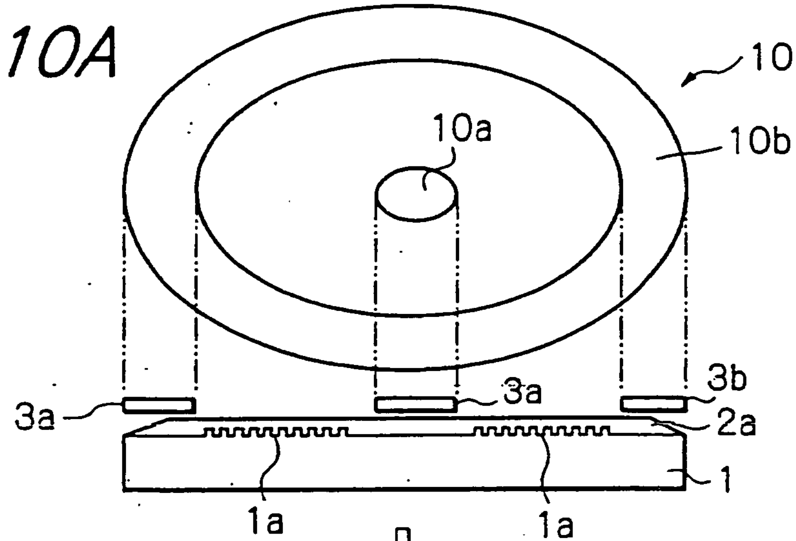


Fig. 10B

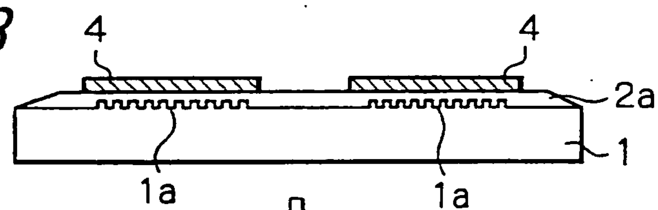


Fig. 10C

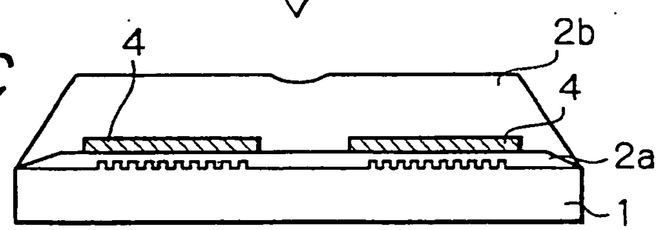


Fig. 10D

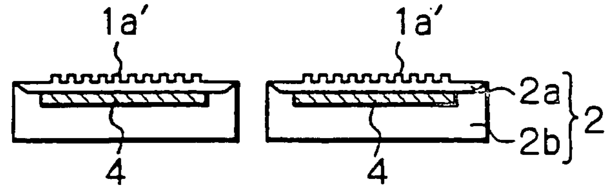
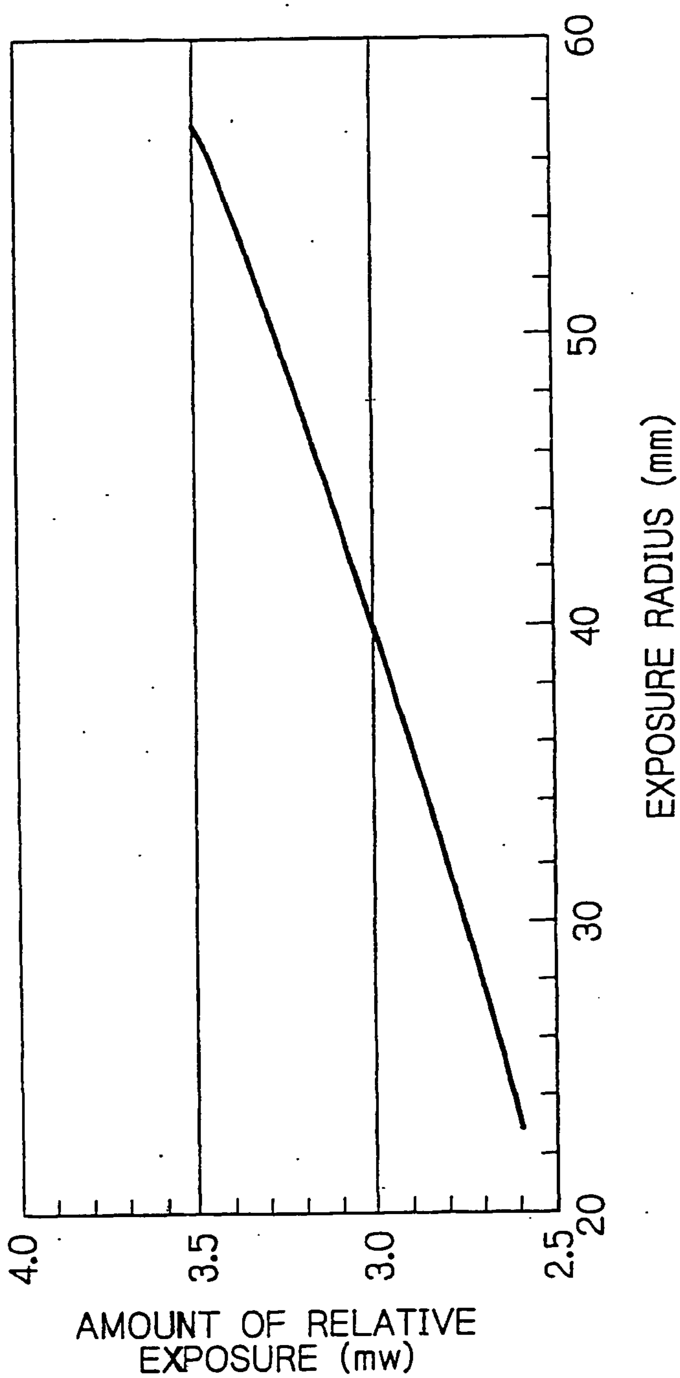


Fig. 12


60
50
40
30
20
EXPOSURE RADIUS (mm)
4.0
3.5
3.0
2.5
AMOUNT OF RELATIVE
EXPOSURE (mw)